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Patent Application for:

AUTOPROGRAMMING FOR DIGITAL TELEVISION

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6 **AUTOPROGRAMMING FOR DIGITAL TELEVISION**

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8 **CROSS REFERENCE TO RELATED DOCUMENTS**

9 This application is a division of co-pending U.S. Serial Number 09/576,878

10 filed May 22, 2000 which is hereby incorporated by reference.

11

12 **FIELD OF THE INVENTION**

13 This invention relates generally to the field of Digital Television (DTV), also

14 referred to as Advanced Television (ATV). More particularly, in certain preferred

15 embodiments, this invention relates to a method and system for tuning an ATSC

16 (the Federal Communication Commission's Advanced Television Systems

17 Committee) compliant digital television for both PSIP (the ATSC's Program System

18 Information Protocol) and MPEG 2 (Moving Picture Expert Group version 2) digital

19 video broadcast format video.

20

21 **BACKGROUND OF THE INVENTION**

22 In the United States, digital television signals can be broadcast using either

23 of two technical standards. The first is MPEG 2 which is mandatory. The second

24 is PSIP which is an optional standard that supports enhanced features. The PSIP

25 standard provides the ability to associate multiple channel frequencies with a single

26 broadcaster for display in the channel guide. The MPEG 2 digital video broadcast

27 standard provides no such capability. For MPEG 2, the major channel displayed

28 in the program guide corresponds directly with the physical channel number

29 (frequency) used to broadcast the digital television signal. For PSIP broadcasts,

1   programming can be broadcast on multiple frequencies yet displayed as a

2   collection of major and minor channels in the program guide for ease of selection

3   by the user. That is, for PSIP, a virtual channel number can represent the physical

4   channel carrying the broadcast whereas in MPEG 2, the concept of a virtual

5   channel does not exist - the major channel number is always the physical channel

6   number associated with a broadcast frequency.

7   These two differing standards create a challenge for design of the digital

8   television receiver. Since each format PSIP and MPEG uses its own Program

9   Specific Information tables as defined in the respective specifications, the television

10   receiver device must be able to distinguish between the two formats and use the

11   Program Specific Information so that the receiver can receive both the PSIP and

12   MPEG standard program formats in a manner which is transparent to the user.

13

14   **SUMMARY OF THE INVENTION**

15   The present invention relates generally to digital television. Objects,

16   advantages and features of the invention will become apparent to those skilled in

17   the art upon consideration of the following detailed description of the invention.

18   In one embodiment consistent with the present invention a method of tuning

19   a digital television receiver includes receiving a command to tune to a major

20   channel and a minor channel; determining whether the major channel is PSIP

21   compliant, and if so: looking up a TSID corresponding to the major channel; looking

22   up a physical channel corresponding to the TSID; tuning a tuner to the physical

23   channel; and determining if the physical channel carries the major and minor

24   channel, and if so, remaining tuned to the physical channel.

25   In another embodiment consistent with the present invention, a method of

26   storing channel information in a digital television receiver, includes tuning to a

27   selected physical channel; reading Program Specific Information on the selected

28   physical channel; storing an indication of whether the physical channel is a PSIP

29   compliant channel; if the selected physical channel is a PSIP compliant channel:

1   storing a TSID corresponding to the selected physical channel; and storing a major

2   channel corresponding to the selected physical channel.

3   In another embodiment consistent with the present invention, a method of

4   autoprogramming channel information in a digital television receiver, includes for

5   each of a plurality of N physical channels: tuning to a selected physical channel;

6   reading Program Specific Information on the selected physical channel; storing an

7   indication of whether the physical channel is a PSIP compliant channel; if the

8   selected physical channel is a compliant PSIP channel: storing a TSID

9   corresponding to the selected physical channel; and storing a major channel

10   corresponding to the selected physical channel.

11   A device for tuning a digital television receiver consistent with another

12   embodiment of the present invention includes a control module. A user module

13   provides an interface to a user and sends commands to the control module to

14   select a major and minor television channel. A tuner tunes to physical channels

15   and produces a digital transport stream of packets. A database stores Program

16   Specific Information from a currently tuned physical channel. A demultiplexer

17   receives the transport stream and produces a demultiplexed data stream

18   representing a tuned television channel. The control module includes program for:

19   determining whether the major channel is PSIP compliant, and if so: looking up a

20   TSID corresponding to the major channel; looking up a physical channel

21   corresponding to the TSID; tuning a tuner to the physical channel; and determining

22   if the physical channel carries the major and minor channel, and if so, remaining

23   tuned to the physical channel.

24

25   **BRIEF DESCRIPTION OF THE DRAWINGS**

26   The features of the invention believed to be novel are set forth with

27   particularity in the appended claims. The invention itself however, both as to

28   organization and method of operation, together with objects and advantages

29   thereof, may be best understood by reference to the following detailed description

of the invention, which describes certain exemplary embodiments of the invention, taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a block diagram of a tuning and autoprogramming system for a digital television receiver (or set top box) in accordance with an embodiment of the present invention.

FIGURE 2 is an illustrative simplified programming guide.

FIGURE 3 is a flow chart of an autoprogramming process consistent with certain embodiments of the present invention.

FIGURE 4 is a flow chart of a process for updating the autoprogramming tables in accordance with an embodiment of the present invention.

FIGURE 5, which is made up of FIGURE 5A, FIGURE 5B, FIGURE 5C and FIGURE 5D is a flow chart of a channel selection process consistent with certain embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail specific embodiments, with the understanding that the present disclosure is to be considered as an example of the principles of the invention and not intended to limit the invention to the specific embodiments shown and described. In the description below, like reference numerals are used to describe the same, similar or corresponding parts in the several views of the drawing.

Before describing the current invention in detail, it is useful to define several of the terms which will be used frequently herein. The term "physical channel" as used herein refers to a broadcast frequency used to transmit digital television programming. In the United States, 68 physical channels are utilized to broadcast digital television. These channels are numbered 2 through 69. The physical channel for broadcasting any particular program can vary from location to location so that the same program might be carried on a different physical channel

depending upon the channel assignment available to local television station. The term "virtual channel" and "major channel" refer to identifiers which typically identify a network or source of programming material such as CBS, ABC, NBC, Fox, etc. The major channel or virtual channel is represented by a major channel number which is used by the television receiver to partially identify a television program. The term "minor channel" is a number which used in conjunction with the major channel number uniquely identifies a television program. For example, a user could tune to channel 2.4 which would indicate major channel 2 minor channel 4 and this channel would uniquely identify a television program. The term TSID or "Transport Stream Identifier" is a number which identifies a transport stream carried on a particular physical channel. The TSID to transport stream association is unique for each transport stream that carries PSIP information; but, it is not necessarily unique for MPEG 2 only transport streams. Thus, two different PSIP transport streams will not have the same TSID value, but two MPEG 2 only transport streams might. Moreover, a PSIP transport stream and an MPEG 2 transport stream might share the same TSID value.

A "program" is defined to generally mean the conventional meaning of a program in the television sense, but a program in digital television is made up of a collection of program elements such as audio elementary streams, video elementary streams, etc. A transport stream may contain several programs multiplexed together if the physical channel bandwidth will support it. For example, MPEG 2 channels 24.1 and 24.2 may share a single transport stream. Finally, a "Packet Identifier" or PID is used to identify each element (packet) in the transport stream with a particular program. Therefore, packets associated with a particular channel will always use a common PID. Each elementary stream is associated with a PID and this association is given by the Program Specific Information present in the transport stream (and stored in a database in the present invention for the currently tuned physical channel as will be explained later.)

Referring now to **FIGURE 1**, the architecture of a DTV Control System in accordance with an embodiment of the present invention is shown as 100. This

1   embodiment may form a part of a digital television set itself, a digital television

2   adapter or a set-top box (STB), or any other device including DVD players and video

3   cassette recorders which incorporate an internal tuning mechanism. The above

4   architecture is used to tune digital television broadcasts. A DTV control module

5   104, which is based upon a programmed processor such as the Trimedia

6   processor produced by Phillips, Inc. in the present embodiment, provides the

7   intelligence for the DTV tuning system of the present invention. DTV control

8   module 104 interfaces with a user module 108 which provides a user interface to

9   the system 100.

10   User module 108 may incorporate a graphical user interface, remote

11   controller interface and/or any other suitable mechanism for interfacing with a user.

12   Commands issued by the user are translated by the user module 108 into a DTV

13   command message 112 destined for the DTV control module 104. DTV control

14   module 104 issues acknowledgments and error codes 116 back to the user module

15   108 along with a unique identifier code for each command 112 which is being

16   acknowledged by an acknowledgment 116. This unique identifier is used so that

17   if multiple commands are issued by the user, only the latest user command is used

18   by the user module 108 to report status etc. to the user. Progress in completion of

19   any commands by the DTV control module 104 is recorded as a DTV progress

20   message 118 back to the user module 108. Such progress messages may be

21   translated into reports to the user or may simply be used internally by the user

22   module 108.

23   When the DTV control module 104 is instructed to select a physical channel

24   by a command 112 from the user module 108 or by an internal routine, a physical

25   channel select command 128 is sent to a tuner module 130. The tuner module

26   receives input signals representing the physical channels 2 through 69 and

27   demodulates the selected channel to produce a stream of packets of digital data

28   referred to herein as transport stream 134. Each transport stream has a transport

29   stream identifier or TSID, and each pakcet has a packet identifier or PID which

30   correlates to a program component (or elementary stream).

1   Upon receipt of the physical channel selection command 128, the tuner

2   module 130 acknowledges or sends an error code 138 back to the DTV control

3   module 104 to indicate receipt of the command or an error. Upon completion of the

4   process of selecting the particular physical channel and settling of all transients

5   associated therewith, a tuning complete status signal 140 is sent from the tuner

6   module 130 to the DTV control module 104.

7   In accord with the ATSC standard, the transport stream 134 may carry

8   multiple programs residing on a single physical channel. These programs are

9   demultiplexed in a demultiplexer 146 in accordance with a packet identifier (PID)

10   selected by DTV control module 104 by a command issued on line 150. The

11   packet identifier is determined by the digital television specification and can be

12   programmed within the digital TV control module 104. Transport stream status

13   information 154 is provided to the DTV control module 104 from demultiplexer 146.

14   One of the advanced features of digital television is the ability to provide

15   program guide information for display by the user on his television set. This

16   information is available in transport stream 134 as a part of the "Program Specific

17   Information" tables for the currently tuned physical channel. As this Program

18   Specific Information is received by demultiplexer 146 relevant data are stored in a

19   database 158 for the currently tuned physical channel. When the database 158has

20   been fully updated for a newly tuned physical channel, an update signal 160 is

21   transmitted from the database 158 to the digital TV control module 104 to provide

22   the module with notification that the database 158 has been updated. DTV control

23   module 104 may then issue queries 164 of database 158 and receive query results

24   170 from the database 158 to ascertain information about the currently tuned

25   physical channel. Whenever a new physical channel is tuned by the tuner module

26   130, the database 158 is reset and repopulated with data from the newly tuned

27   physical channel's Program Specific Information tables.

28   Referring to **FIGURE 2**, a simple example of a program guide as might be

29   displayed on the user's television set is illustrated as 200. The first block of

30   programs shown as CBS 4 represent a collection of minor channels 1, 2 and 3

associated with three different television programs all of which use virtual channel or major channel 4. The second collection of programs referred to as PBS 24 show two programs which are associated with two minor channels forming a part of major channel 24.

By way of example, when any one of minor channels 1, 2 or 3 of major channel 4 is tuned by the tuner module 130 and demultiplexer 146, the database 158 captures the transient information associated with the tuned physical channel. In the case of major channel 4, in this example assume major channel 4 is a PSIP channel with data shown in **TABLE 1**. In addition to including television show name, rating, closed captioning information as well as a description of the programming and other useful information, the Program Specific Information includes the information shown in **TABLE 1** which relate major plus minor channel to a physical channel and a TSID. Since three different physical channels are associated with the major channel (virtual channel) 4, this is clearly a PSIP format broadcast stream. Only one program is present on this physical channel, and it is uniquely identified within the transport stream by the TSID and the PID obtained from the Program Specific Information stored in the database 158 for the currently tuned channel.

DATABASE DATA / TRANSPORT STREAM SYSTEM DATA			
MAJOR CHANNEL	MINOR CHANNEL	PHYSICAL CHANNEL	TSID
4	1	57	381
4	2	16	101
4	3	12	122

TABLE 1

1	In order to tune to any given television program as identified by major plus
2	minor channel (either by direct selection by the user or by incrementing up or down
3	to the next channel or any other mechanism which ultimately delivers a major plus
4	minor channel to the DTV control module 104) the DTV control module 104
5	associates the major channel and minor channel with a physical channel and
6	packet ID (PID) in order to tune to the channel. The present invention utilizes an
7	autoprogramming function to populate three static tables which are stored in non-
8	volatile memory (for example flash memory) so that during the channel selection
9	process the digital TV control module 104 may ascertain how to tune tuner module
10	130 to any particular selected program.
11	The static information (which rarely changes except during an
12	autoprogramming process) stored in the non-volatile memory in accordance with
13	one embodiment of the invention is stored in three tables shown as **TABLES 2, 3**
14	and **4** below and referred to respectively as the PSIP/MPEG Table, the Major/TSID
15	Table and the Physical/TSID Table respectively. Collectively, these tables are
16	referred to as the autoprogramming tables. The autoprogramming process in
17	accordance with an embodiment of the present invention is illustrated in **FIGURE**
18	**3** as process 300. This process generally is a process for systematically stepping
19	through each of the physical channels, tuning to the physical channels one by one
20	and extracting from the resulting database information for the currently tuned
21	physical channel (including major channel information and TSID information
22	associated with the major channel) from the Program Specific Information tables
23	in the transport stream 134. This information is stored in **TABLES 3** and **4** for all
24	PSIP channels, with **TABLE 2** providing a directory of PSIP vs. MPEG channels.
25	Recall that for MPEG channels, the major channel number is identical to the
26	physical channel and can be tuned directly.
27	
28	
29	

PSIP / MPEG TABLE	
MAJOR CHANNEL	PSIP CHANNEL?
4	YES
24	NO
29	YES
39	NO
45	NO
56	NO

TABLE 2

MAJOR / TSID TABLE	
MAJOR CHANNEL	TSID
4	381
29	136

TABLE 3

PHYSICAL / TSID TABLE	
PHYSICAL CHANNEL	TSID
12	122
16	101
19	136
57	381

TABLE 4

1   Referring now to **FIGURE 3**, the autoprogramming process begins at
2   304upon receipt of an autoprogram command by the DTV control module 104
3   issued as a DTV command 112 from user module 108 in response to a user
4   command to autoprogram or another event which automatically triggers an
5   autoprogram process. In the event an error occurs at 304, the process terminates
6   at 308 without further action except possibly issuance of an error message.
7   Assuming the command is received and can be executed at 304, an acknowledge
8   message 116 along with a unique command ID is sent from DTV control module
9   104 to user module 108 as acknowledgment 116 at 310.

10 At 314 the physical channel is set to the first physical channel (typically 2)
11 and control passes to 318. At 318 the DTV control module 104 sends a select
12 physical channel command 128 to tuner module 130 to select the currently
13 selected physical channel and start an autoprogramming timer. Control then
14 passes to 322 where the DTV control module 104 awaits either a tuner or a timer
15 event message. Under normal circumstances, a tuner event (a message 140
16 indicating completion of tuning to the selected physical channel by tuner 130) will
17 occur before the autoprogramming timer times out so that a tuner event is detected
18 at 326 via a tuning complete status signal 140. Upon receipt of the tuner event at
19 326, the database 158 is cleared with a reset and acquisition of new database
20 information for database 158 is commenced at 330. When the autoprogramming
21 timer expires at 334, enough time has passed for both the tuner 130 to acquire the
22 selected physical channel and the new information to have been completely
23 acquired at 330. At 334, the timer event has completed and the database
24 information is normally present. Thus, **TABLES 2, 3** and **4** can be updated at 340.

25 Assuming a valid physical channel was found and the tables were properly
26 updated at 340, the process of scanning the current physical channel is completed
27 at 342 and an appropriate report is set as a DTV progress message 118 from the
28 DTV control module 104 to the user module 108. In the event a signal was not
29 found at 326 (i.e. no physical channel information was present on the currently

tuned physical channel at 326) or no database information was found at the end of

the autoprogramming timer at 334, the tables are not updated at 340 and an error

report is generated at 342 indicating to the user module 108 that a valid channel

was not found. If the current physical channel is not the last physical channel

(usually channel 69) at 346, the physical channel is incremented at 350 and control

returns to 318 where the tuner selects the next physical channel and repeats the

process. If the physical channel was the last physical channel at 346, a report is

generated to user module 108 indicating that the autoprogramming process is

complete at 356 and the process terminates at 308.

Referring now to **FIGURE 4**, stage 340 of updating the **TABLES 2** through

4 is described in greater detail. This process begins with querying of database 158

at 404 and first determining if the currently tuned physical channel is a PSIP

channel at 408. If not, the PSIP/MPEG Table (**TABLE 2**) is updated by indicating

that the currently selected channel is not a PSIP channel at 412. In this case, by

knowing that the channel is not a PSIP channel it must be an MPEG channel

therefore the major channel is equal to the physical channel, and further population

of **TABLES 3** and **4** is not needed.

In the event the currently selected physical channel is a PSIP channel at

408, the PSIP/MPEG Table (**TABLE 2**) is updated to indicate that the current major

channel is in fact a PSIP channel at 422. Control then passes to 428 where the

TSID is read from the database 158 for the currently tuned physical channel and the

Physical/TSID Table (**TABLE 4**) is updated. Control then passes to 434 where the

major channel for the current TSID is read from the database 158 and the

Major/TSID Table (**TABLE 3**) is updated. When 412 or 434 is completed, stage

340 has been completed and control passes to 342 of **FIGURE 3.**

Those skilled in the art will recognize that the relationship between TSID and

major channel as listed in **TABLE 3** is not a unique one-to-one relationship. In fact,

the relationship from major channel to TSID may be a one-to-many relationship

since a major channel as shown in **TABLE 1** may have, for example, three physical

1   channels and TSID's associated with major channel 4. For purposes of the present

2   invention, it is only important that one valid relationship is stored in non-volatile

3   memory which relates the major channel to one of the TSID's for the major

4   channel. As the process of **FIGURE 3** is implemented, it makes no difference

5   whether or not the Major/TSID Table (**TABLE 3**) is updated when a new TSID is

6   encountered for an existing major channel or whether the originally stored major

7   channel to TSID relationship is retained for those major channels having multiple

8   TSID's. It is only important that one valid major channel TSID relationship be stored

9   in **TABLE 3**.

10   In the example shown in **TABLE 1**, the autoprogramming process for major

11   channel 4 proceeds by first determining that the major channel 4 is a PSIP channel

12   and indicating adjacent the major channel 4 entry in **TABLE 2** that it is a PSIP

13   channel. Major channel 4 will first be encountered in the autoprogramming process

14   upon tuning to physical channel 12. Thus, the TSID for physical channel 12 will be

15   entered into **TABLE 4**. Next, **TABLE 3** will be updated with a TSID of 122 from

16   **TABLE 1** in **TABLE 3**. When physical channel 16 is encountered, it is again

17   determined to be a PSIP channel associated with major channel 4 which is already

18   in **TABLE 2**. **TABLE 4** is then updated with a TSID of 101 for physical channel 16

19   and **TABLE 3** may be updated from 122 as the TSID associated with major channel

20   4 to 101 as the TSID associated with major channel 4. When the physical channel

21   is finally tuned to physical channel 57, **TABLE 4** is updated to associate 381 as the

22   TSID for physical channel 57 and **TABLE 3** is updated to change the TSID

23   associated with major channel 4 to 381. In the above scenario, **TABLE 3** could

24   equally well have remained TSID 122 associated with major channel 4. As

25   previously mentioned, it is only necessary that there be a correct index from the

26   TSID to the correct major channel.

27   Once all of the above information is stored in **TABLES 2, 3** and **4**, the tuning

28   system 100 of **FIGURE 1** can be used to tune any desired program as selected

29   from a program guide such as **FIGURE 2** or alternatively selected by incrementing

1   the channel up or down or using any other selection technique. The information
2   stored in **TABLES 2, 3** and **4** is assumed by the system to be static information and
3   is stored in non-volatile memory. In the event of a change in any of this information,
4   a new autoprogramming sequence should be instituted to update the information
5   in order for the receiver to be able to continue to correctly receive the television
6   programming. Referring now to **FIGURE 5**, which is broken into **FIGURES 5A, 5B,**
7   **5C** and **5D**, the channel selection process in accordance with an embodiment of
8   the present invention is illustrated. In this process, starting at **FIGURE 5A**, the DTV
9   control module 104 receives channel selection information in the form of the DTV
10 command 112 from user module 108. This channel selection command includes
11 major and minor channel numbers. When this channel information is received at
12 502 by the DTV control module 104, the DTV control module 104 checks the static
13 non-volatile memory for **TABLES 2, 3** and **4** to determine if the major channel
14 selected is among those in the autoprogramming tables at 506. If not, the channel
15 selection command is acknowledged with an acknowledgment which includes a
16 command identifier and the user module 108 is notified by the DTV control module
17 104 that the command is invalid at 508. The process then terminates at 510.
18   If the major channel is in the autoprogramming tables at 506, control passes
19 to 512 where **TABLE 2** is consulted to determine if the major channel is a PSIP
20 channel or an MPEG 2 channel at 512. If it is an MPEG 2 channel at 512, the
21 physical channel is set equal to the major channel at 516 and control passes to
22 518. At 518 if the physical channel is equal to the current physical channel, at this
23 point an acknowledgment 116 is returned to user module 108 along with an
24 appropriate command identifier and a report that no acquisition is needed at 522.
25 Control then passes to the process of **FIGURE 5B** starting with the connector **B**.
26 If at 518, the physical channel is not equal to the current physical channel, an
27 acknowledgment message 116 is sent from the DTV control module 104 to the
28 user module 108 along with a report that acquisition is needed in order to tune to
29 the correct physical channel at 526. The tuner is then set for the correct physical

channel at 528 and control again passes to connector **B** and the process of **FIGURE 5B**.

At 530 a channel selection timer is started and control passes to 532 where a timer event or a database update event is awaited. In the event a database update event occurs first at 534 and the major plus minor channel is not found at 534, control returns to 532 until the channel selection timer event occurs. When the timer expires at 532, the timer event causes 538 to determine if the major plus minor is in the database 158. If the major plus minor channel is in the database at either 534 or 538, control passes to 540. In either event, at 540 the program packet identifiers are enabled so that the DTV control module 104 selects the appropriate packet identifier using 150 to extract the appropriate program from the transport stream 134. At 542, a report and command identifier is sent to the user module 108 with the report indicating that the channel selection is complete and the channel has been found. The channel selection process then terminates at 510. In the event the major plus minor channel is not present in the database 158 at 538 upon expiry of the channel selection timer, control passes to 546 where a report and command identifier is sent to the user module 108 from the DTV control module 104 indicating that the channel selection is complete but the channel was not found. The process then terminates at 510.

Referring back to **FIGURE 5A**, if the major channel is a PSIP channel at 512, control passes to the process of **FIGURE 5C** beginning at connector **A**. At 550, the TSID is determined from the major channel using the Major/TSID Table (**TABLE 3**). Control then passes to 552 where the physical channel is looked up for the TSID using the Physical/TSID Table (**TABLE 4**). Control then passes to 554 which determines whether the physical channel is equal to the current physical channel. If not, the process of **FIGURE 5D** is invoked as will be discussed later. If so, control passes to 558 where the TSID associated with the current program including both major and minor channels is obtained from the database 158. Since the current physical channel is the physical channel desired, the most accurate up-to-date

1   information should currently be stored in database 158. Control then passes to 560

2   where the physical channel is determined for the TSID from the Physical/TSID

3   Table (**TABLE 4**).

4   If the physical channel determined from the Physical/TSID Table in 560 is

5   equal to the current physical channel at 562, the channel selection is

6   acknowledged and the command ID is forwarded from the DTV control module 104

7   as an acknowledgment 116 to the user module 108 along with a report that no

8   acquisition is needed at 564. Control then passes to the process of **FIGURE 5B**

9   at connector **B**. In the event the physical channel is not equal to the current

10   physical channel at 562, control passes again to connector **C** of **FIGURE 5D**.

11   Referring now to **FIGURE 5D**, the process beginning with connector **C** is

12   illustrated beginning with an acknowledgment message 116 which is sent from the

13   DTV control module 104 to the user module 108 along with a command ID and a

14   report that acquisition is needed to tune to the selected channel at 568. At 572 the

15   tuner is set for the physical channel determined at either 552 or 560 of **FIGURE 5C**.

16   The channel selection timer is started at 574 and control passes to 576 where a

17   database update event or a timer event is awaited.

18   When a database update event is received, and the selected major plus

19   minor channel is not in the database 158, control returns to 576 to await another

20   database update event or a timer event. In the event of a timer event at 580 if the

21   major plus minor channel is now in the database 158, control passes to 582.

22   Control also passes from 578 to 582 in the event the major plus minor channel is

23   found in the database 158. Control then passes to 584 where the physical channel

24   is determined for the TSID from the Physical/TSID Table. If the physical channel

25   is not equal to the current physical channel at 586 control returns to 572 where the

26   tuner is reset for the physical channel. If the physical channel is equal to the

27   current physical channel at 586, the PID's are enabled for selection at 150 to

28   extract the appropriate program from the transport stream 134 at 588. Control then

29   passes to 590 where a report including a command identifier is sent from the DTV

control module 104 to user module 108 along with a report that the channel selection is complete and the channel has been found at 590. The process then terminates at 510.

In the event at the end of the channel selection timer the major plus minor channel is not found in the database 158 at 580, a report and command ID is sent from the DTV control module 104 to the user module 108 at 596 indicating that the channel selection is complete, but the channel is not found. The process then terminates at 510.

In the above scenario, if the user was tuning to channel 4.1 instead of 4.2 physical channel 57 would have been the correct channel initially and an iteration of the tuning process would not have been necessary. In the event the user wished to tune to channel 24.1, the DTV control module 104 would ascertain from **TABLE 2** that the major channel 24 is not a PSIP channel but is in fact an MPEG 2 channel. Thus, the physical channel is set equal to the major channel and physical channel 24 is tuned by the tuner module 130. The data stream then associated with minor channel 1 of major channel 24 is simply extracted from the transport stream 134 by a demultiplexer 146 using the appropriate PID in order to select the program associated with channel 24.1.

In accordance with the above invention, if the user wishes to tune, for example, to channel 4.2, the DTV control module 104 determines from the PSIP/MPEG Table that major channel 4 is a PSIP channel. The major channel is then determined from the Major/TSID Table to have a TSID of 381. TSID 381 is then determined from the physical TSID Table to be associated with physical channel 57. The tuner module 130 is thus directed by the DTV control module 104 to tune physical channel 57.

Once channel 57 is tuned, the DTV control module 104 determines from the database 158 that program material for minor channel 4.2 is not present. Recall that minor channel 4.2 as shown in **TABLE 1** is physical channel 16 with TSID 101. However, since physical channel 57 is a part of major channel 4 all of the

1	information of **TABLE 1** is available in database 158 once the physical channel has
2	been tuned to any of the physical channels associated with major channel 4. Thus,
3	the DTV control module 104 is able to ascertain from the database 158 that
4	channel 4.2 actually has a TSID of 101 and is associated with physical channel 16.
5	Accordingly, the DTV control module 104 instructs tuner 130 to tune to physical
6	channel 16. Upon completion of the tuner module 130 tuning to physical channel
7	16, the demultiplexer 146 is able to extract the program material associated with
8	the packet identifier (PID) for major channel 4.2 from the transport stream 134 and
9	the tuning process is complete.
10	Once the program is playing, the DTV control module104 monitors the
11	database 158 for any significant changes. Every time the content of database158
12	is modified, an update message is sent to the DTV control module 104. The DTV
13	control module 104 then queries the database 158 and compares the new data
14	with the old one. The DTV control module 104 then makes the appropriate
15	changes (new elementary PIDs, new content rating, new caption descriptor, new
16	event, etc...) and notifies the user module 108 if needed. The multiplexer 146
17	and/or turner module 130 also notify the DTV control module 104 in case there is
18	any change in the input signal status (signal lost, bad synchronization, errors, etc.).
19	If the signal is lost, the DTV control module 104 resets the database 158, notifies
20	the user module 108 and waits for the signal to be acquired again or for the user
21	to issue another DTV command 112.
22	Those skilled in the art will recognize that there are other mechanisms for
23	implementing the processes described above. For example, rather than using 3
24	tables (**TABLES 2** through **4**) each having two columns, a single table as illustrated
25	below as **TABLE 5** can be utilized to carry all of the information of **TABLES 2, 3**
26	and **4** in a single table with four columns.
27	
28	

AUTOPROGRAMMING TABLE (SECOND EMBODIMENT)			
MAJOR CHANNEL	PSIP?	TSID	PHYSICAL CHANNEL
4	YES	122	12
4	YES	101	16
4	YES	381	57
24	NO	-	24
29	YES	136	19
39	NO	-	39
45	NO	-	45
56	NO	-	56

TABLE 5

Those skilled in the art will recognize that the present invention has been described in terms of exemplary embodiments based upon use of a programmed processor forming a part of the DTV Control Module 104. However, the invention should not be so limited, since the present invention could be implemented using hardware component equivalents such as special purpose hardware and/or dedicated processors which are equivalents to the invention as described and claimed. Similarly, general purpose computers, microprocessor based computers, micro-controllers, optical computers, analog computers, dedicated processors and/or dedicated hard wired logic may be used to construct alternative equivalent embodiments of the present invention.

Those skilled in the art will also appreciate that the architecture disclosed herein is exemplary. Other architectures which divide the functionality of a module and/or combine the functionality of the modules will occur to those skilled in the art and are contemplated as equivalents to the presently disclosed architecture.

The present invention may be modified in many ways without departing from the present invention. For example, as disclosed above, the autoprogramming

1	tables are only modified during the autoprogramming process. If any of the table
2	values are changed after the last autoprogramming, the DTV control module 104
3	might not be able to tune correctly to the channel. The only message displayed in
4	that case is "No Program". However, in an alternative embodiment, when tuning
5	to such a modified physical channel where the signal is present, it is possible to
6	detect inconsistencies between the autoprogramming tables and the current
7	content of the database 158. It is then be possible, in some cases, to automatically
8	modify the content of the autoprogramming tables, remove the outdated information
9	and replace it with the updated information so that the change is transparent for the
10	user. In other embodiments, a warning message can be displayed asking the user
11	to autoprogram the channel list again in the event such a change is detected.
12	While the invention has been described in conjunction with specific
13	embodiments, it is evident that many alternatives, modifications, permutations and
14	variations will become apparent to those skilled in the art in light of the foregoing
15	description. Accordingly, it is intended that the present invention embrace all such
16	alternatives, modifications and variations as fall within the scope of the appended
17	claims.
18	What is claimed is:
19	
20	